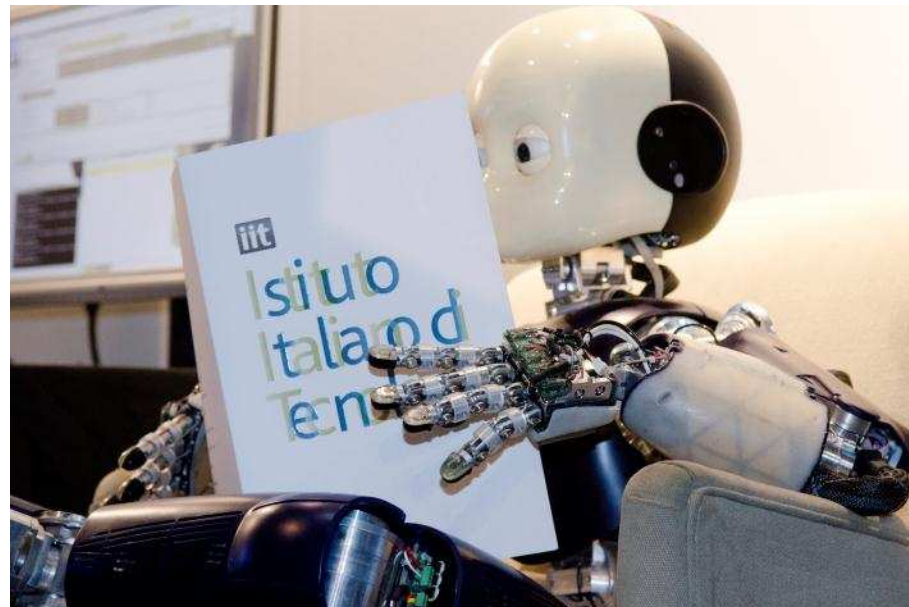


Lorenzo Natale
iCub Facility
Istituto Italiano di Tecnologia, Genova

VVV13, 7th iCub Summer School
July 2013, Sestri Levante

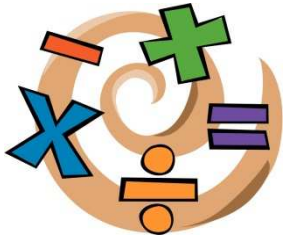


Motivations





The iCub Facility: the ingredients



research/science

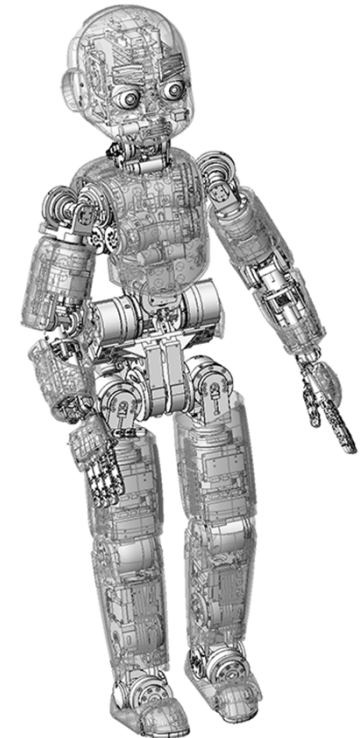
*research in e.g. cognition, vision, mechatronics,
learning, materials, speech...*



engineering/community

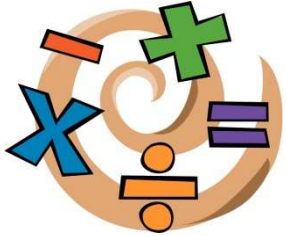
iCub & friends

Program complex behaviors: integration





The iCub Facility: the ingredients



research/science

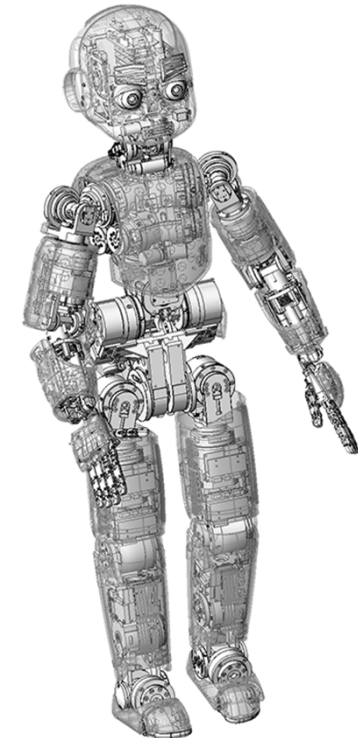
*research in e.g. cognition, vision, mechatronics,
learning, materials, speech...*



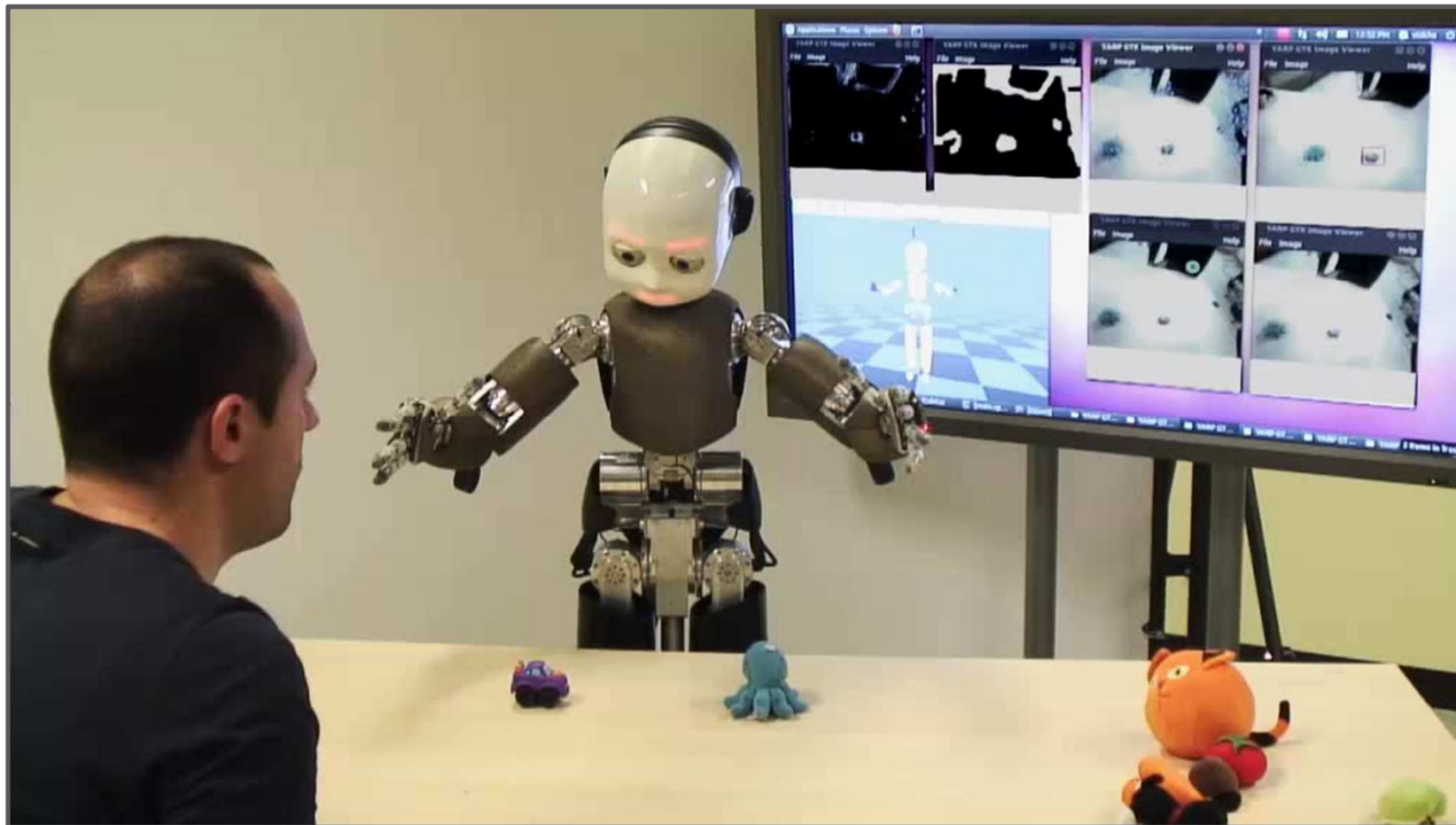
engineering/community

~~iCub & friends~~

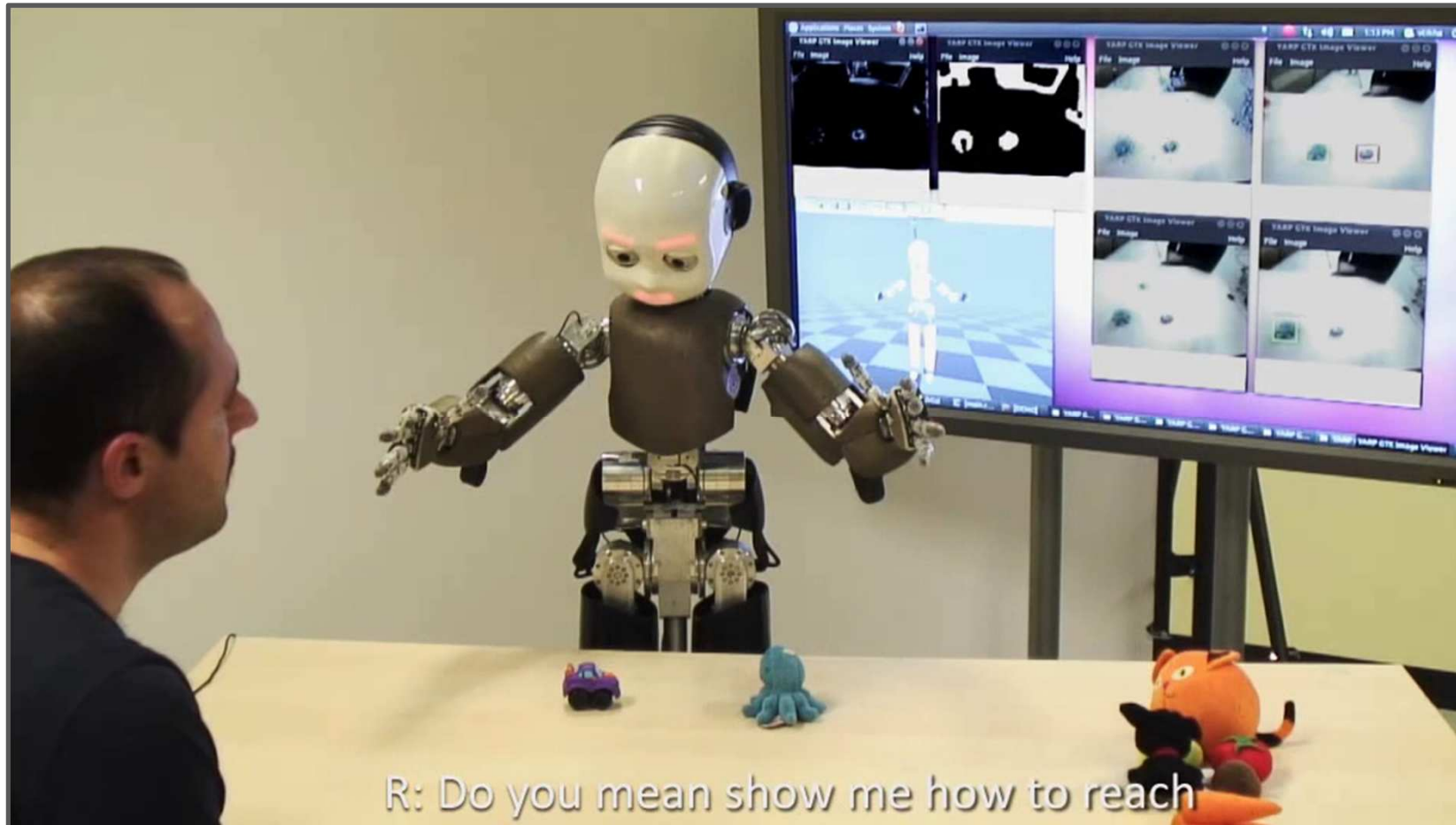
Software integration: programming
complex behaviors



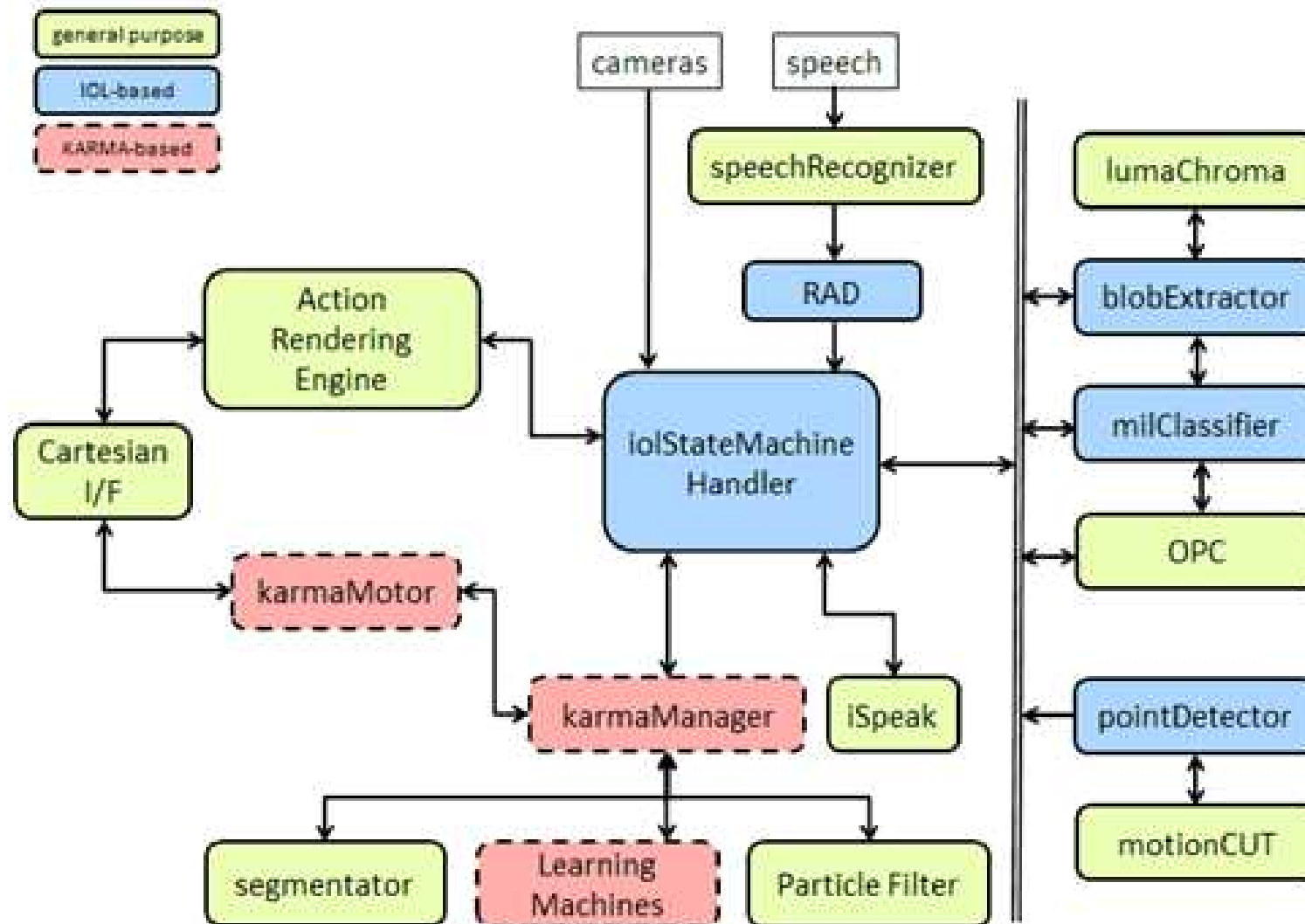
Complex behaviors



Complex behaviors

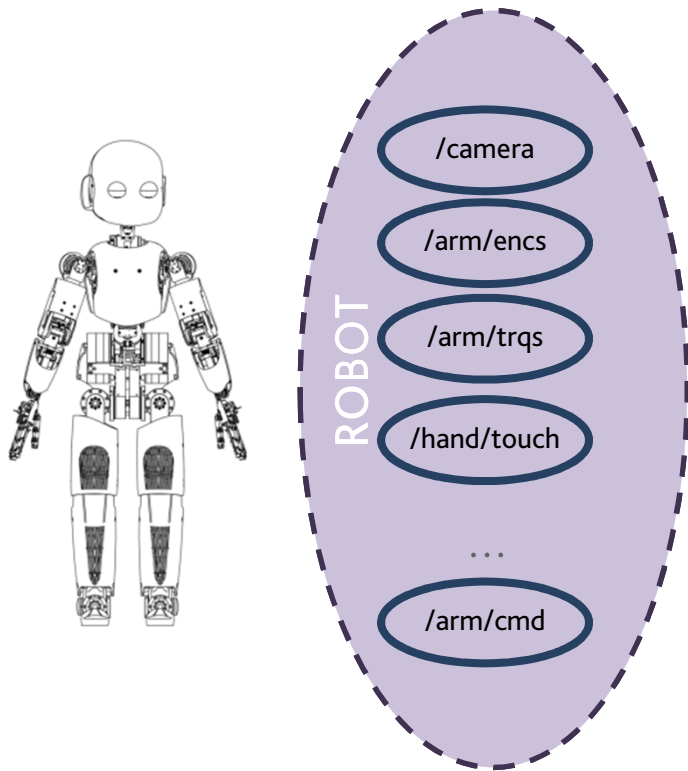


Complex behaviors



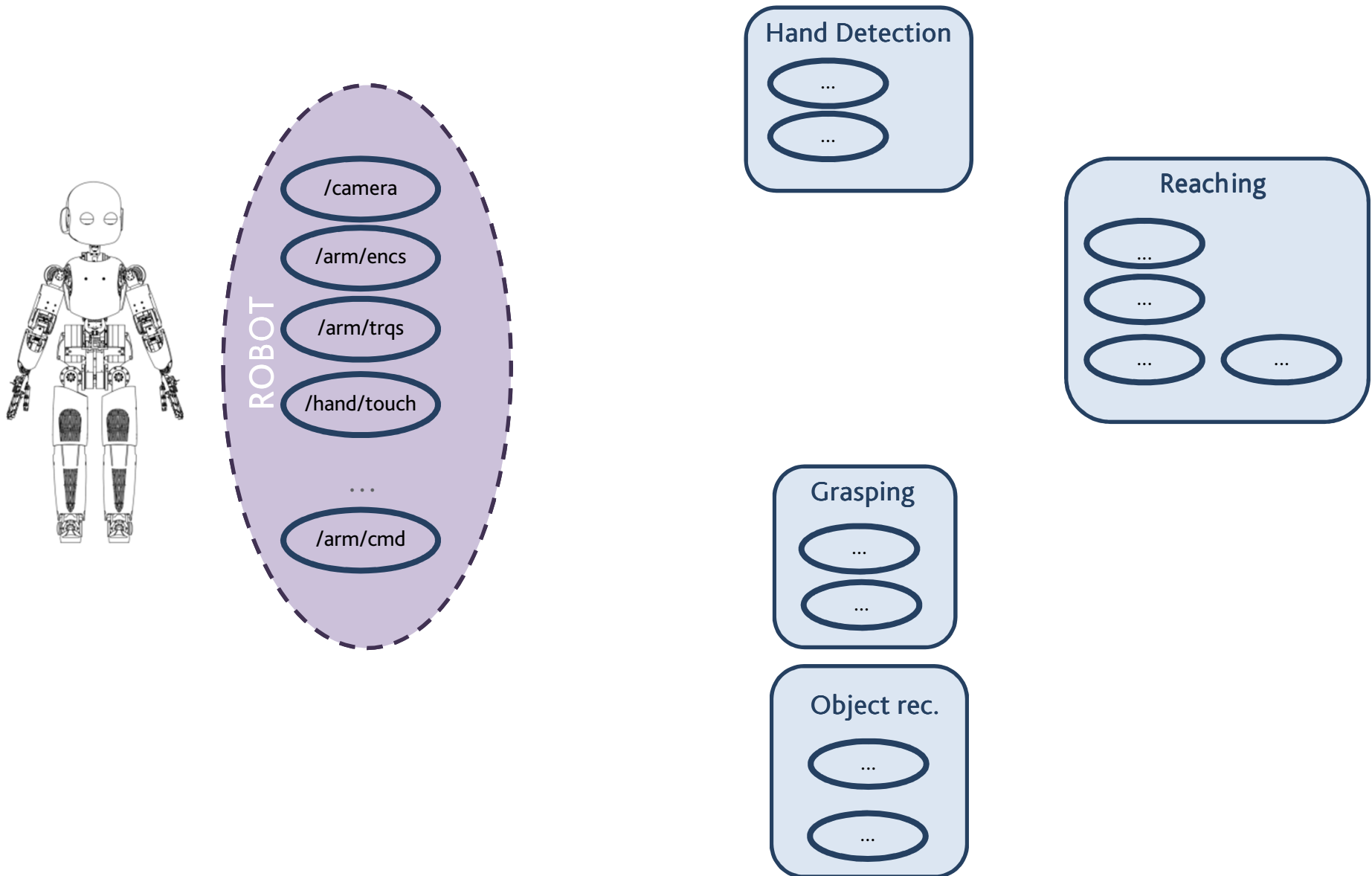


iCub software architecture

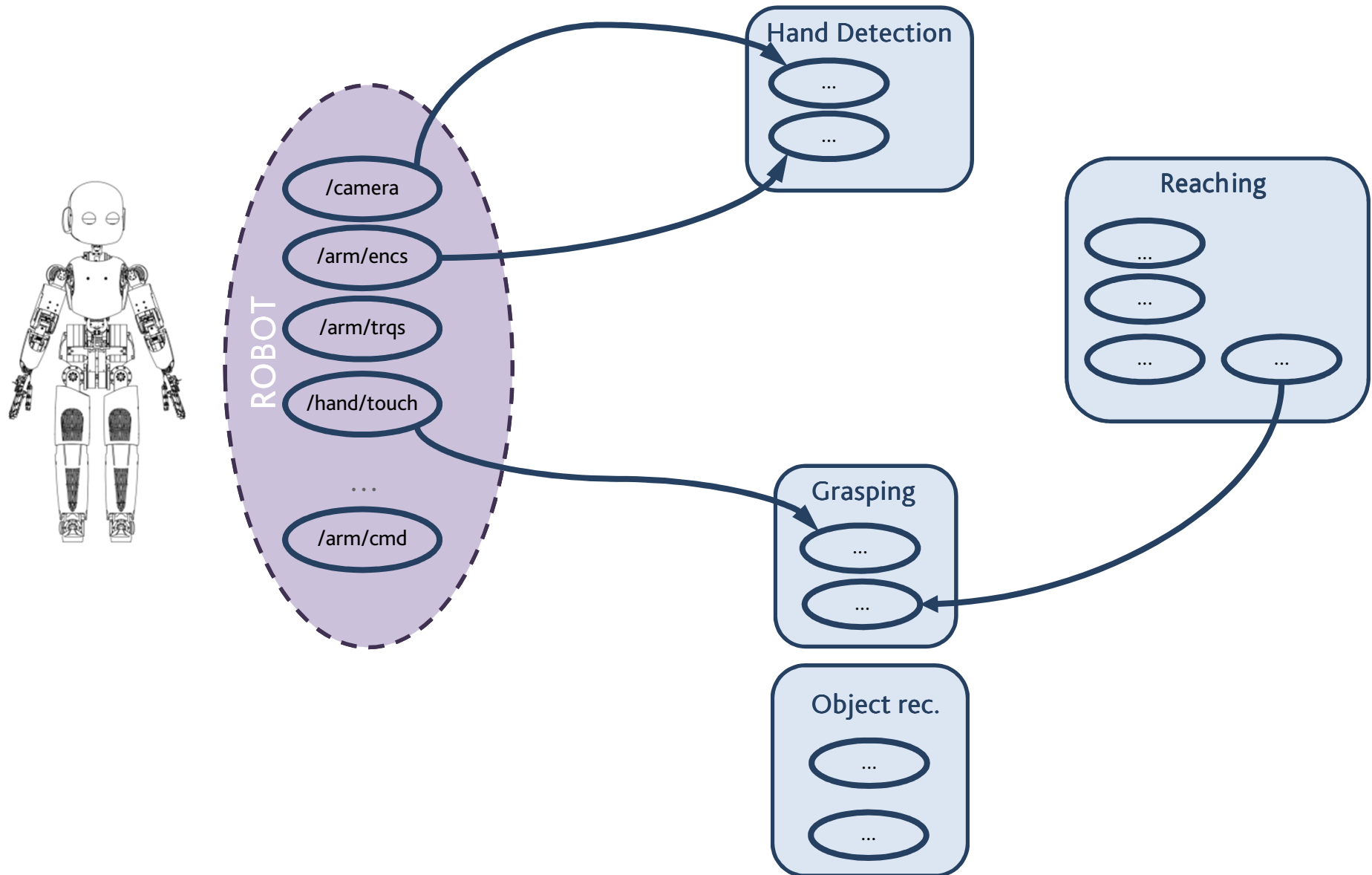




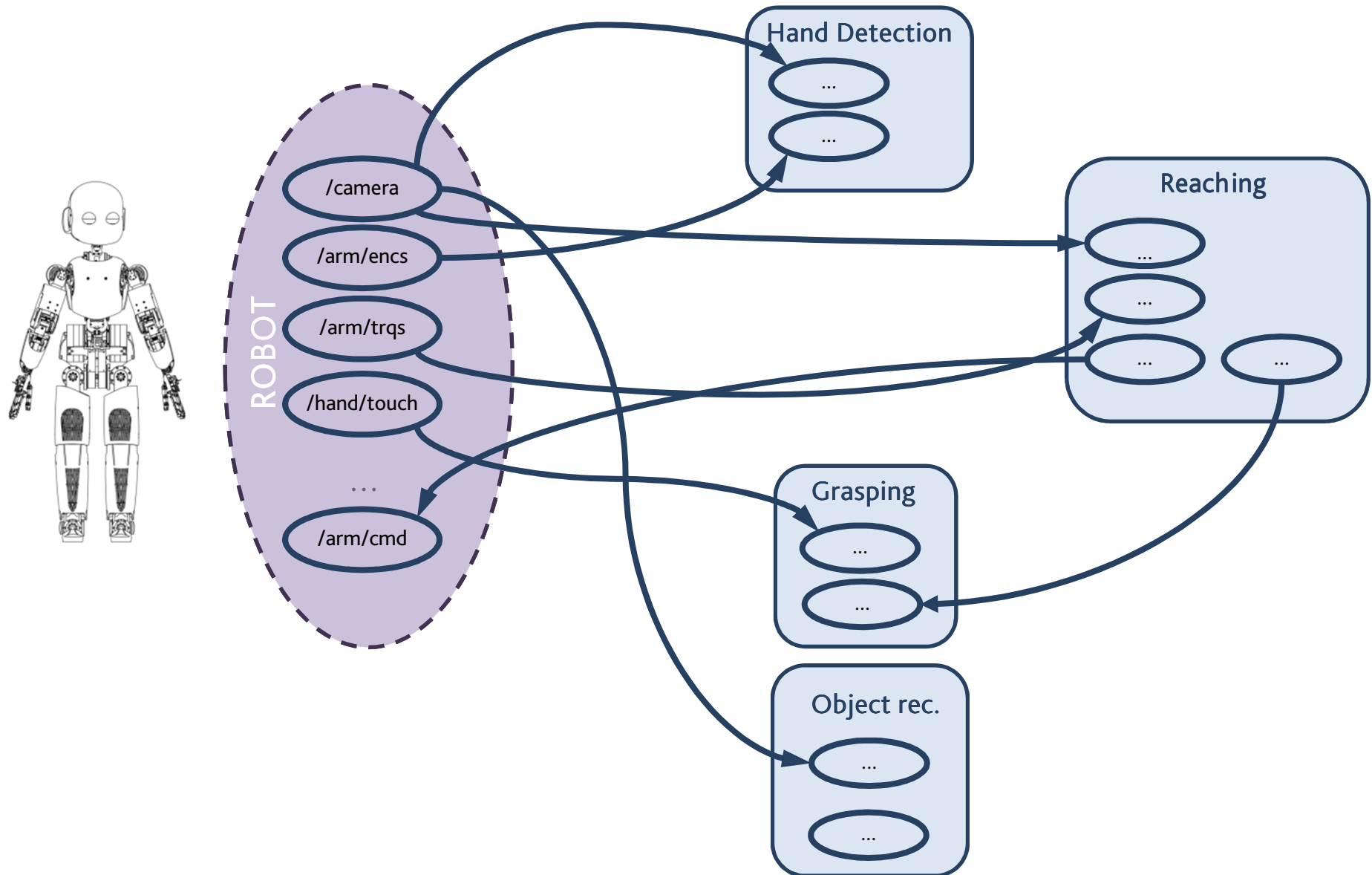
iCub software architecture



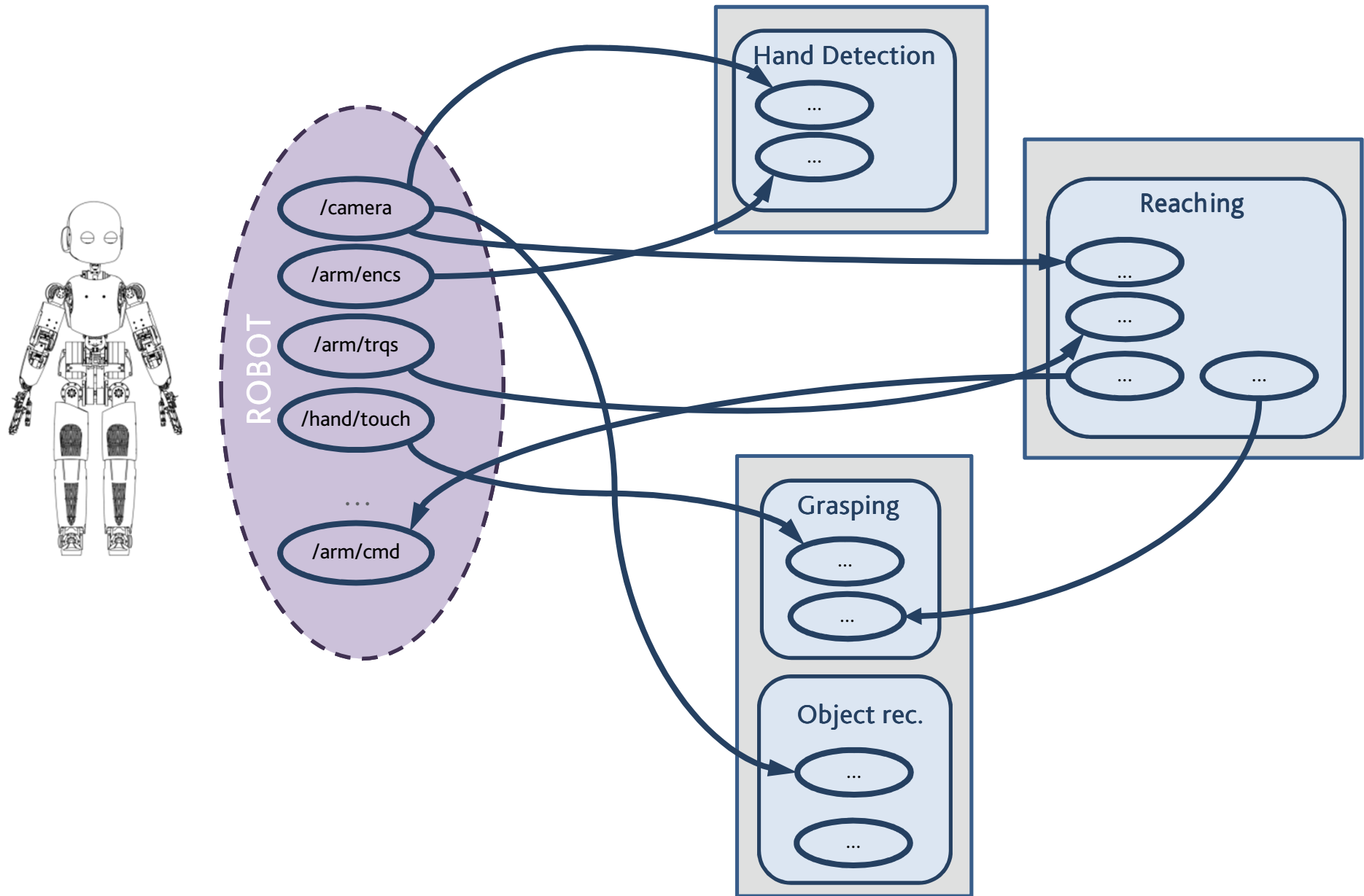
iCub software architecture



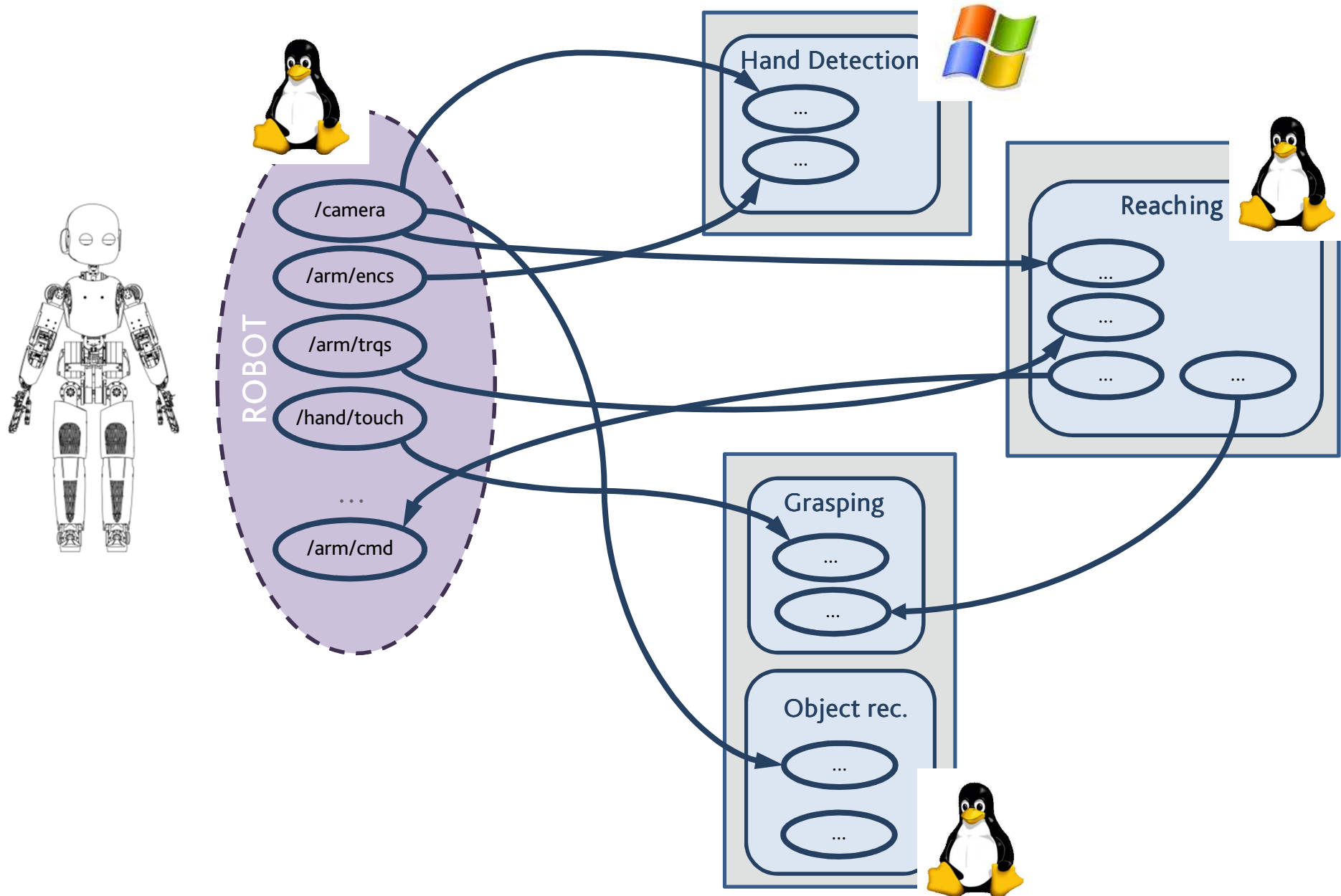
iCub software architecture



iCub software architecture



iCub software architecture





YARP



- Peer-to-peer, **loosely coupled**, communication
- Very stable code base >10 years old
- **Flexibility** and minimal **dependencies**, fits well with other systems
- Easy install with **binaries** on many OSes/distributions (Ubuntu, Debian, Windows, MacOS), see:
http://wiki.icub.org/wiki/YARP_Supported_Distributions
- Several **protocols**:
 - Built-in: tcp/udp/mcast
 - Plug-ins: ROS tcp, xml rpc, mjpg etc..



CMake
Cross-platform Make





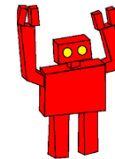
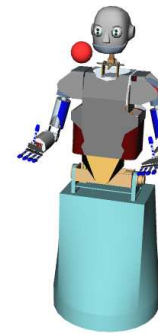
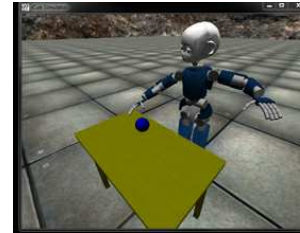
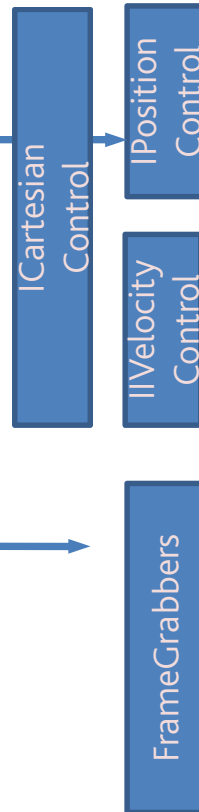
Interfaces

- Define interfaces for motor control, device drivers so to minimize the impact of changes in the hardware
- Also: network stubs allow remotization

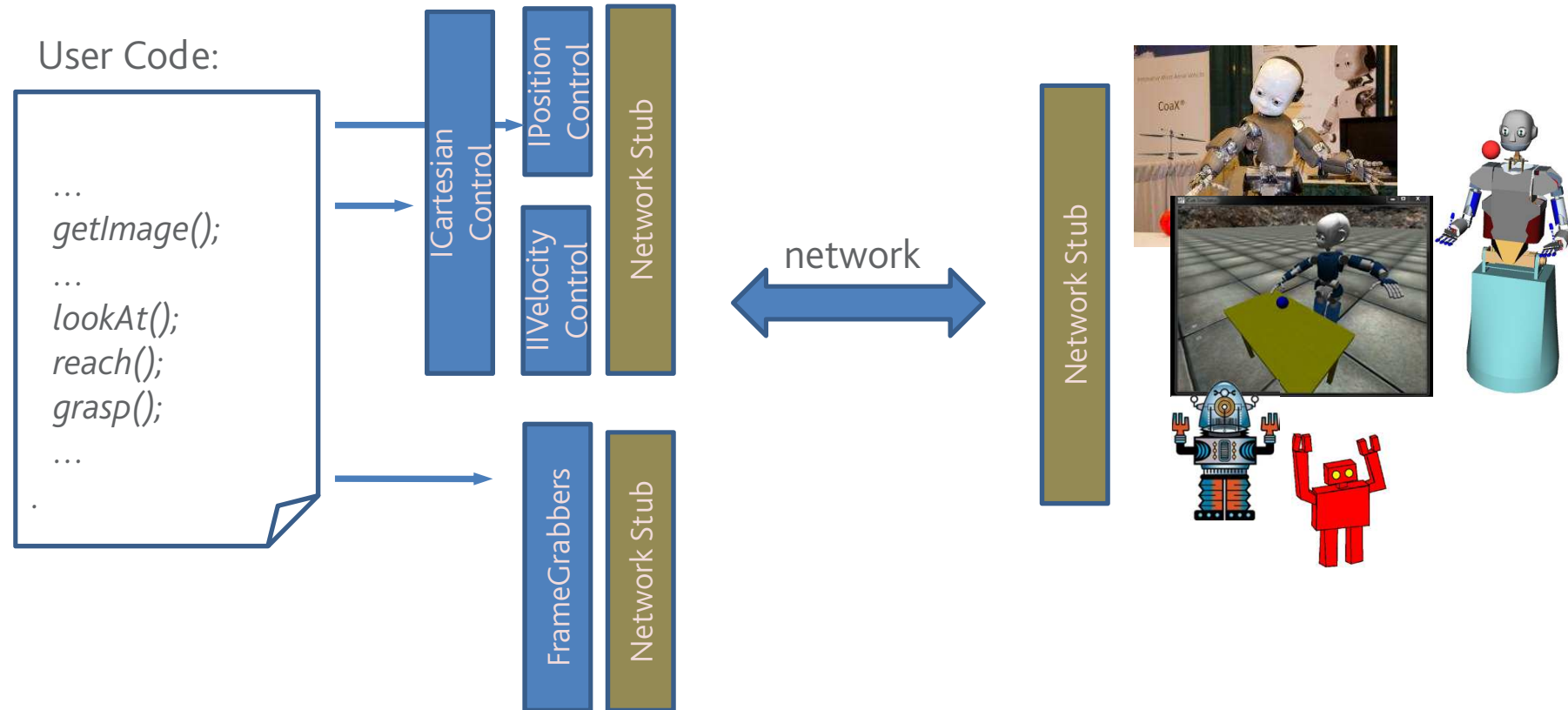
Interfaces

User Code:

```
...
getImage();
...
lookAt();
reach();
grasp();
...
.
```



Interfaces





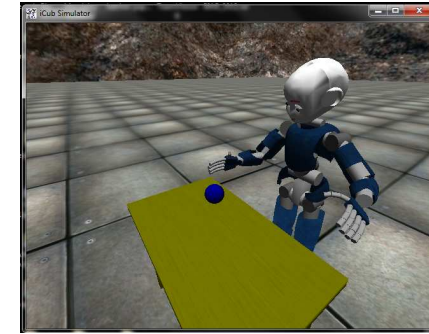
YARP plugins

- YARP includes a plugin system for drivers and protocols (carriers)
- Interchangeable carriers allow:
 - interfacing existing software with ports (without bridges)
 - change significantly port behavior
- Examples:
 - ROS, mjpeg, xml rpc, etc...
 - bayer carrier, priority based communication



Tools: working offline

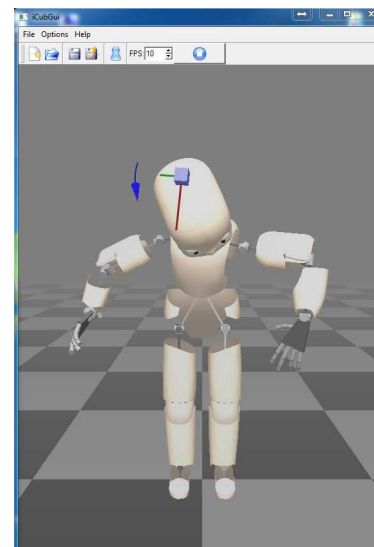
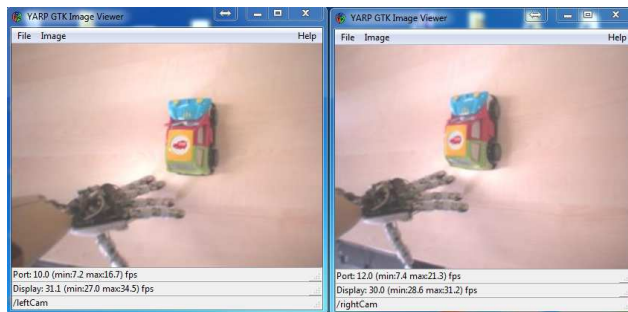
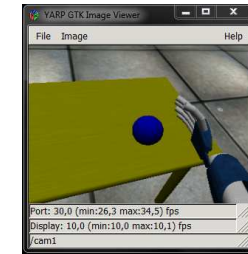
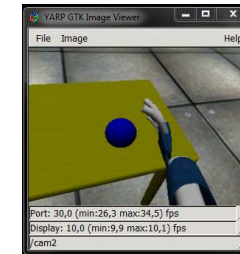
- Data collector/player
- Simulator
- GUIs



Active	Part	Type	Frames	Sample Rate	Port Name	Status
<input checked="" type="checkbox"/>	calibMatrix_left	Bottle	1333	106 ms	/calibMatrix/left:o	33 %
<input checked="" type="checkbox"/>	calibMatrix_right	Bottle	1720	103 ms	/calibMatrix/right:o	33 %
<input checked="" type="checkbox"/>	head	Bottle	6327	6 ms	/icub/head/state:o	29 %
<input checked="" type="checkbox"/>	images_left	Image:ppm	1444	63 ms	/icub/camcalib/left/out	30 %
<input checked="" type="checkbox"/>	images_right	Image:ppm	1832	69 ms	/icub/camcalib/right/out	30 %
<input checked="" type="checkbox"/>	inertial	Bottle	12614	1 ms	/icub/inertial	29 %
<input checked="" type="checkbox"/>	leftArm	Bottle	6052	24 ms	/icub/left_arm/state:o	30 %
<input checked="" type="checkbox"/>	leftLeg	Bottle	6384	24 ms	/icub/left_leg/state:o	29 %
<input checked="" type="checkbox"/>	plots	Image:ppm	225	682 ms	/karmaLearn/plot:o	35 %
<input checked="" type="checkbox"/>	rightArm	Bottle	6377	25 ms	/icub/right_arm/state:o	29 %
<input checked="" type="checkbox"/>	rightLeg	Bottle	6078	24 ms	/icub/right_leg/state:o	30 %
<input checked="" type="checkbox"/>	torso	Bottle	6042	25 ms	/icub/torso/state:o	31 %

Speed: 2.0x

C:\Users\Carlo\Desktop\dataTEST





Repositories and online resources

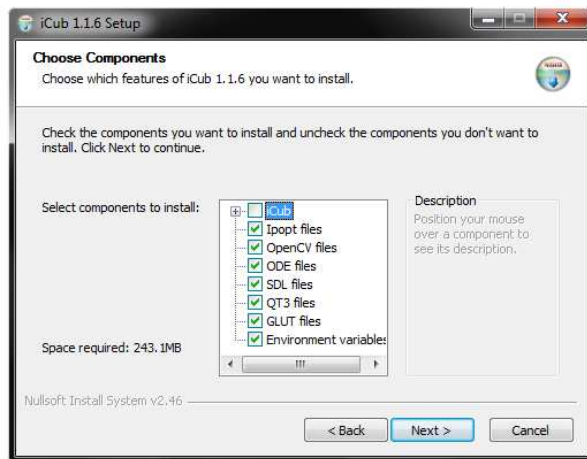
- YARP online documentation: www.yarp.it
- iCub: <http://wiki.icub.org>
- Github: <https://github.com/robotology>
 - yarp
 - codyco
- Sourceforge:
 - Robotcub (iCub: main and contrib, poeticon++, emorph, darwin)
 - efaa
 - xperience



Binaries



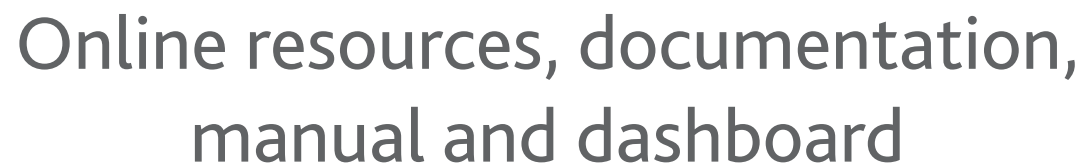
Libraries and modules for
motor control, machine
learning, vision...



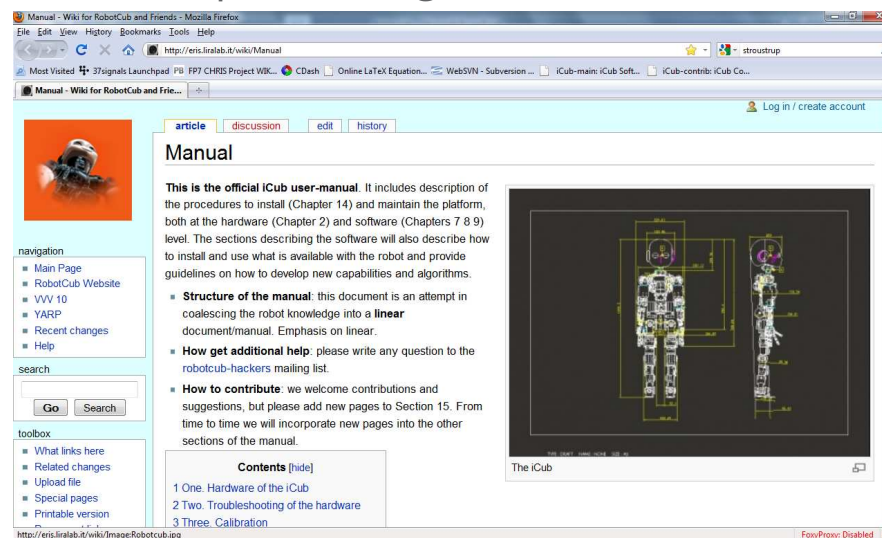
wiki.icub.org/iCub


- Software Installation
- Tutorials




































<http://icub.org> → iCub Manual












Cub



Facility Services List - Cub




















































All Bookmarks



Cub










No updates since Monday, May 20 2012 - 00:00 CEST








Monday, May 20 2012 12:20:39 CEST



Highly



Site



Build Name



Updates



Configure



Build



Test



Build Time



FARMICUBP



ARM



v102-v85-peg-01



Files



Error



Warn



Error



Warn



Not Run



Fail



Pass



May 20 2012 - 02:10 CEST



FARMICUBP



ARM



v102-v85-peg-build-01



Files



Error



Warn



Error



Warn



Not Run



Fail



Pass



May 20 2012 - 02:22 CEST



FARMICUBP



ARM



v102-v85-peg-build-01


Files


Error


Warn


Error


Warn

Not Run

Fail

Pass

May 20 2012 - 03:04 CEST

FARMICUBP

ARM

v102-v85-peg-build-01

Files

Error

Warn

Error

Warn

Not Run

Fail

Pass

May 20 2012 - 03:04 CEST

FARMICUBP

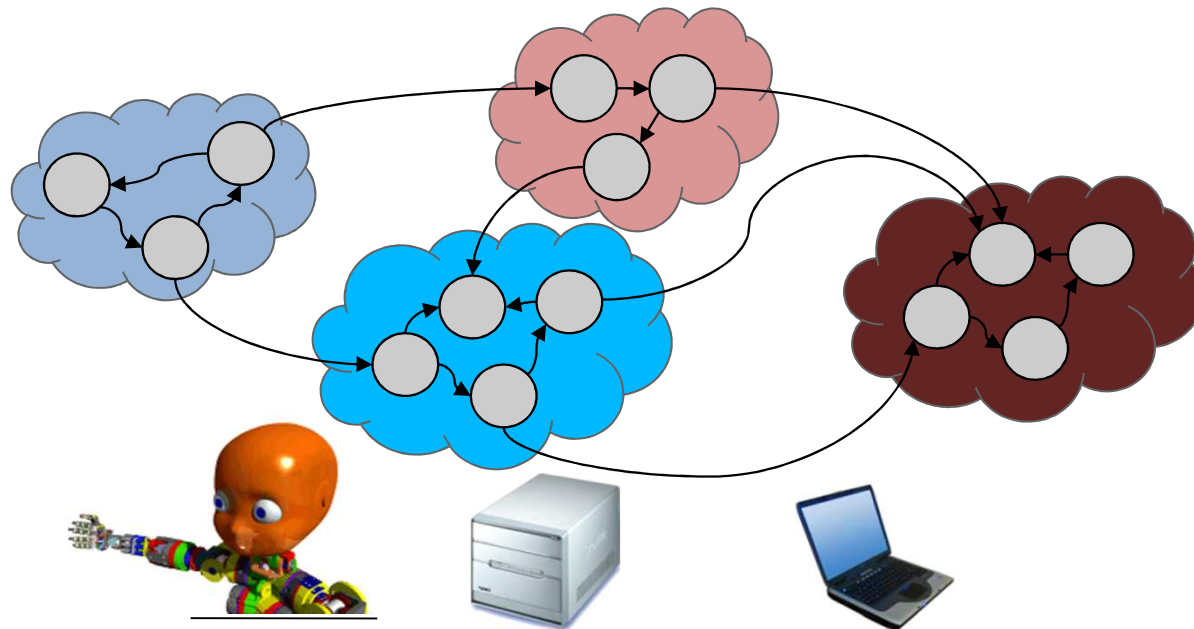
ARM

v1

<http://dashboard.icub.org>

Modularity: where to draw the line?

- Libraries
- Components (processes)
- Functionalities (group of components)



Managing complexity

In a modular system integration becomes an issue:

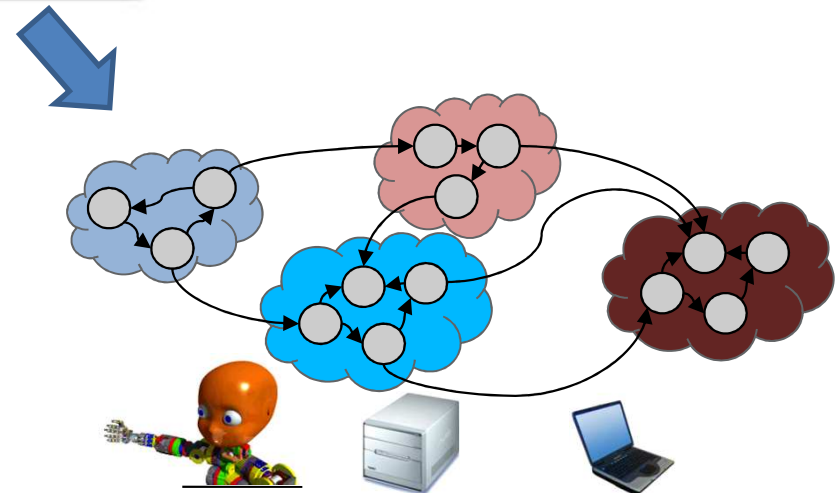
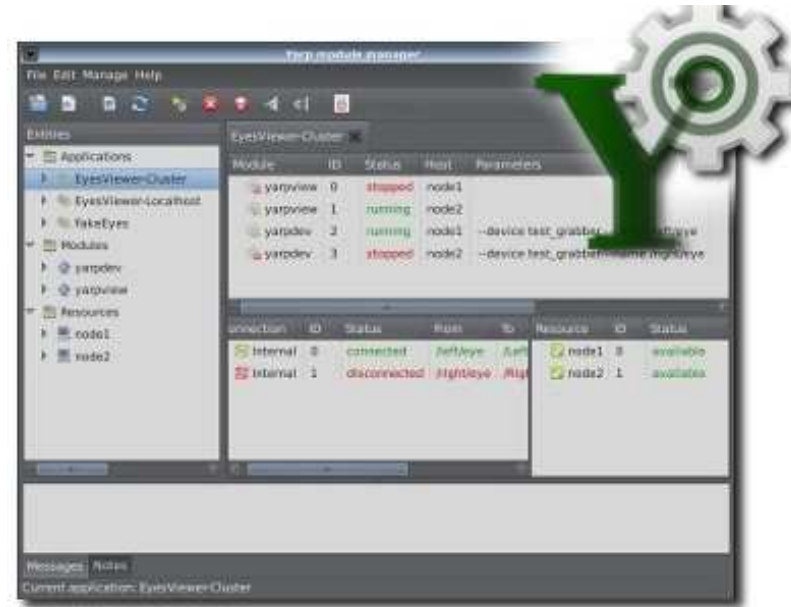
- Execution and monitoring
- Development
- Coordination



Execution and monitoring: yarp manager

Required
modules
connections
nodes
resources

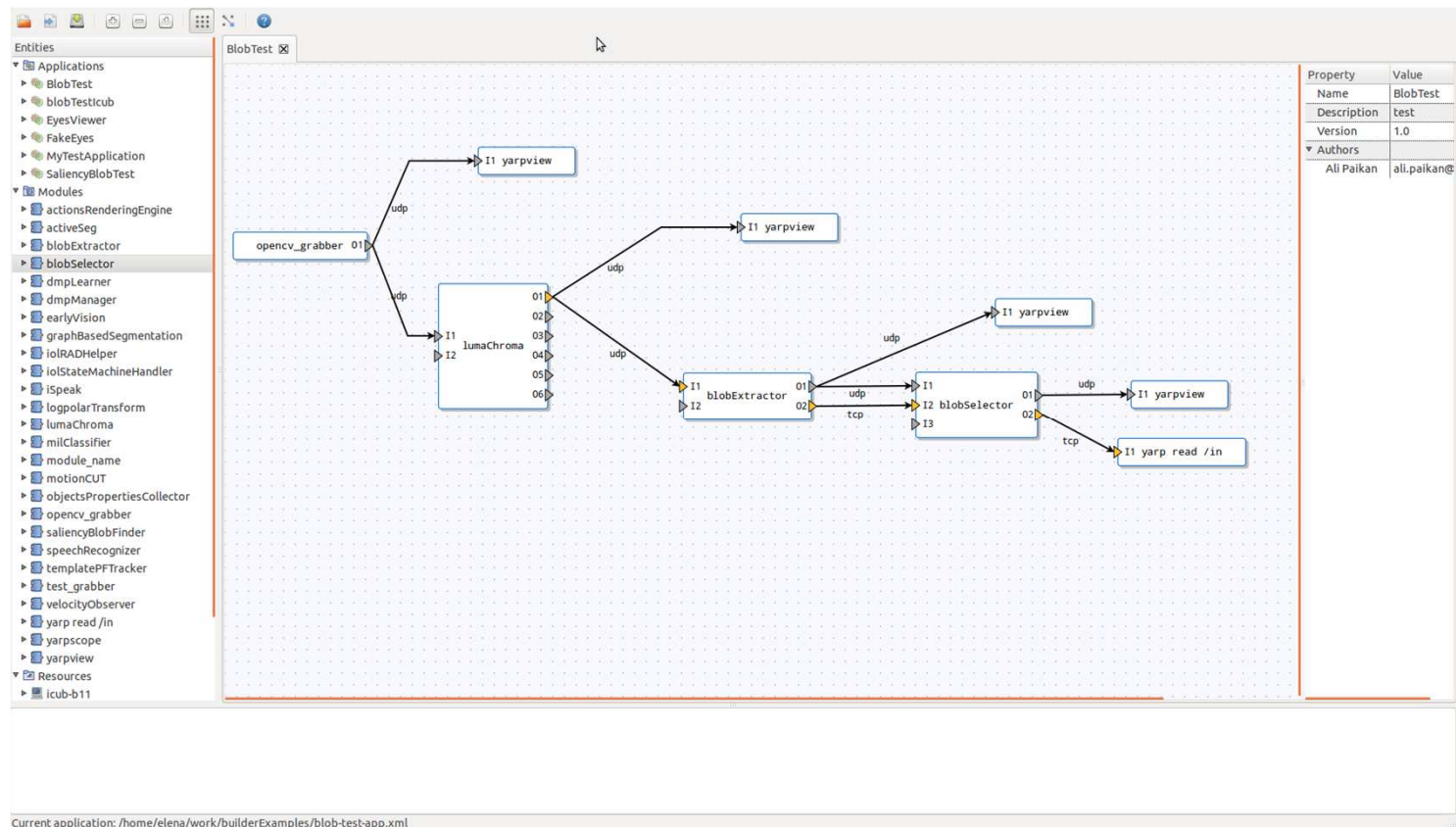
Available
resources



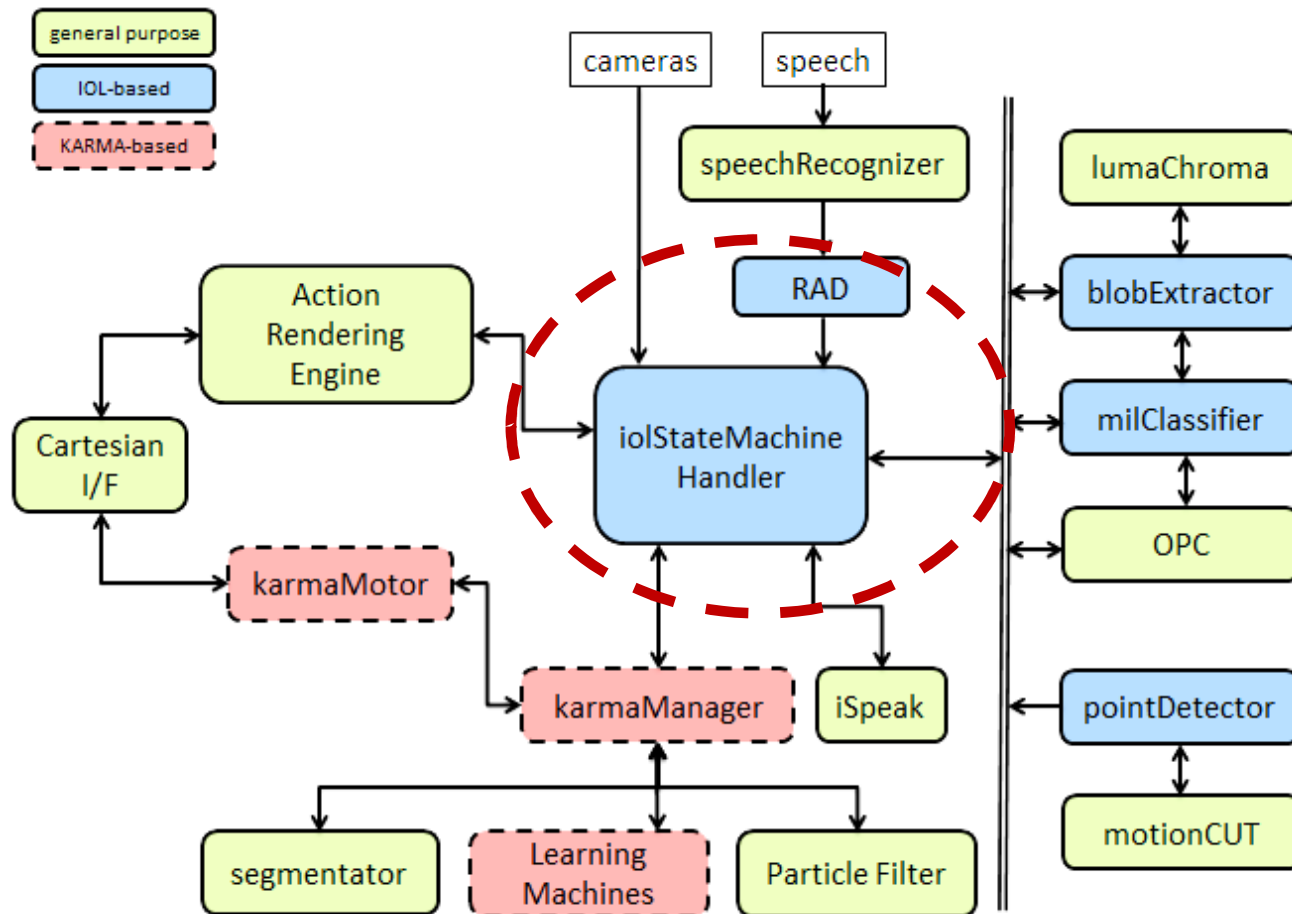


Tools for rapid development

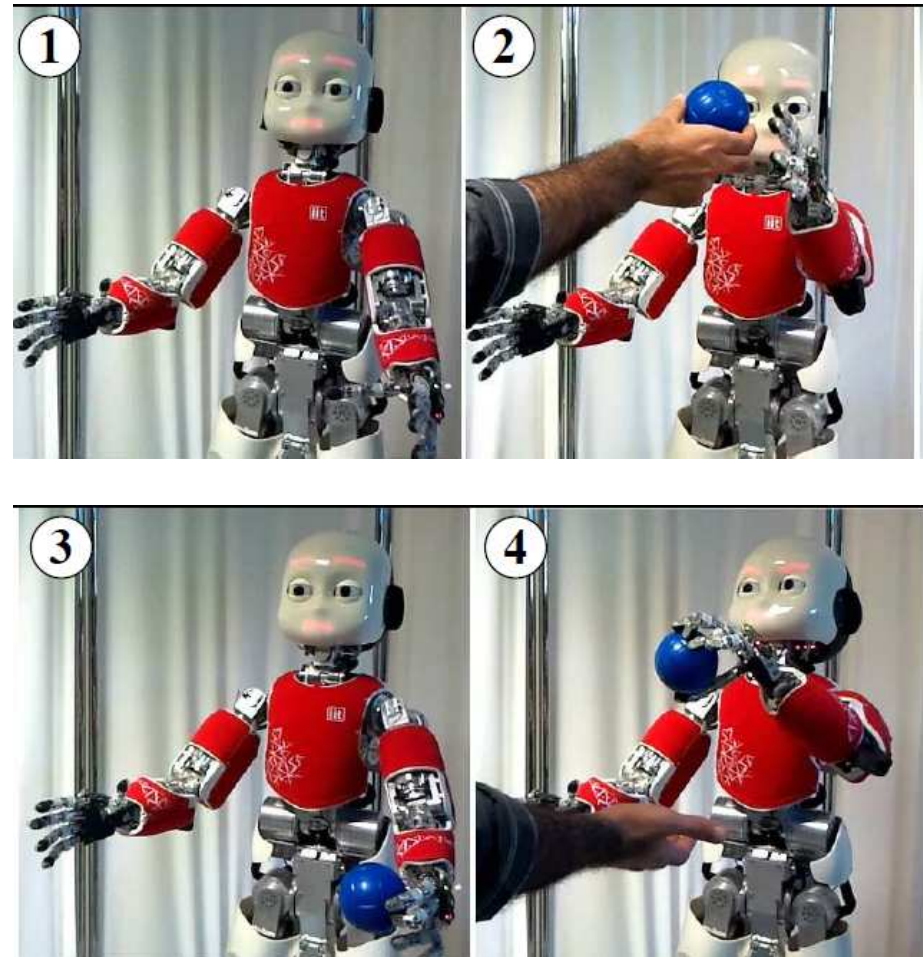
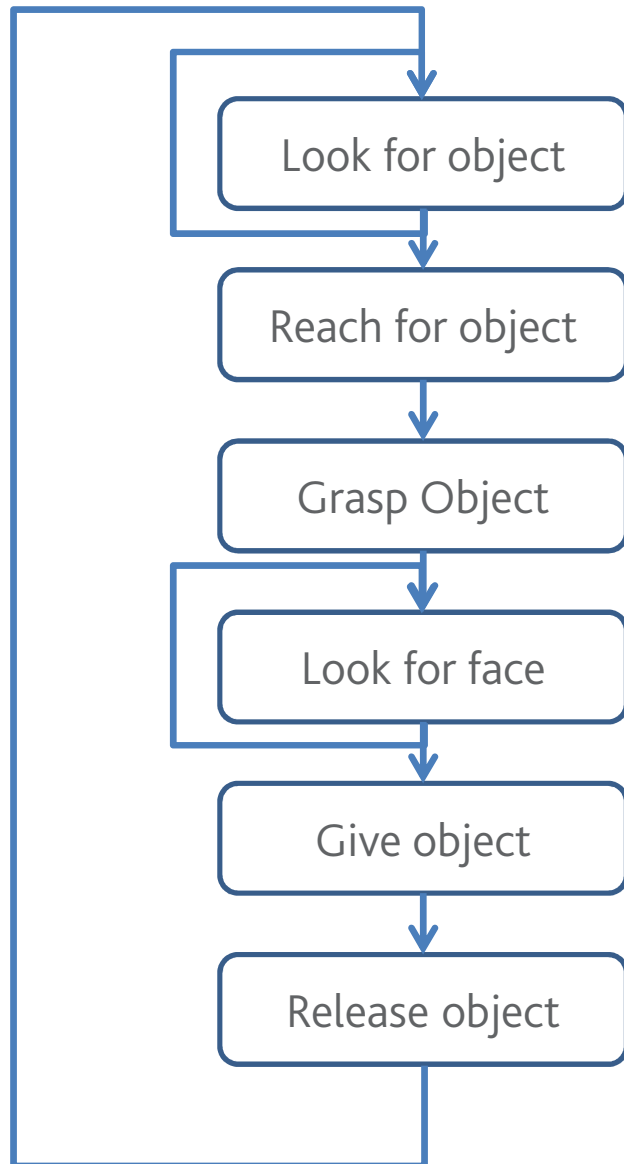
- YARP builder: graphical tool to design application
- Interface Definition Language (IDL):
 - formalization of types and interfaces between modules
 - automatic generation of message handlers



Coordinating modules

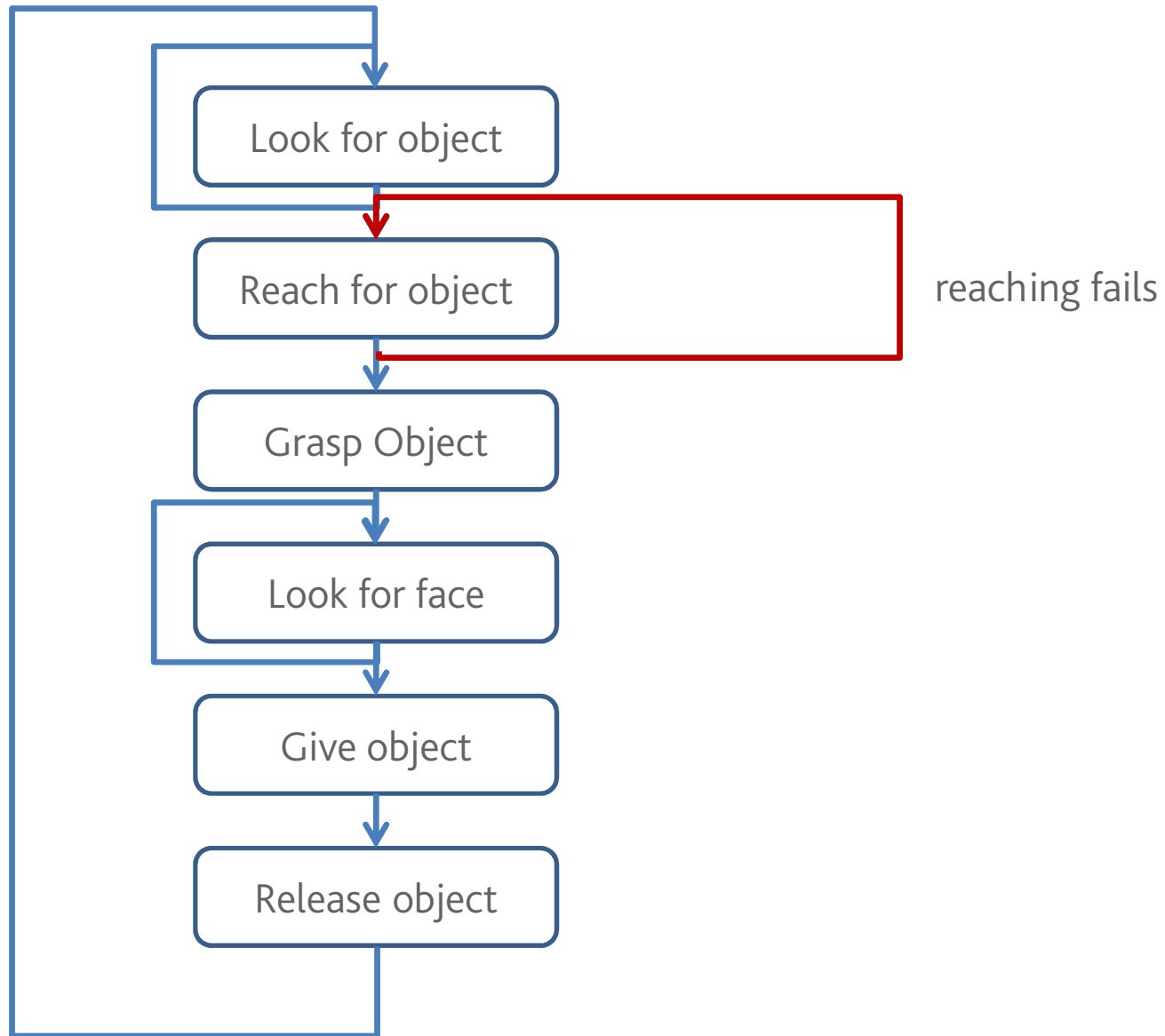


Take & return

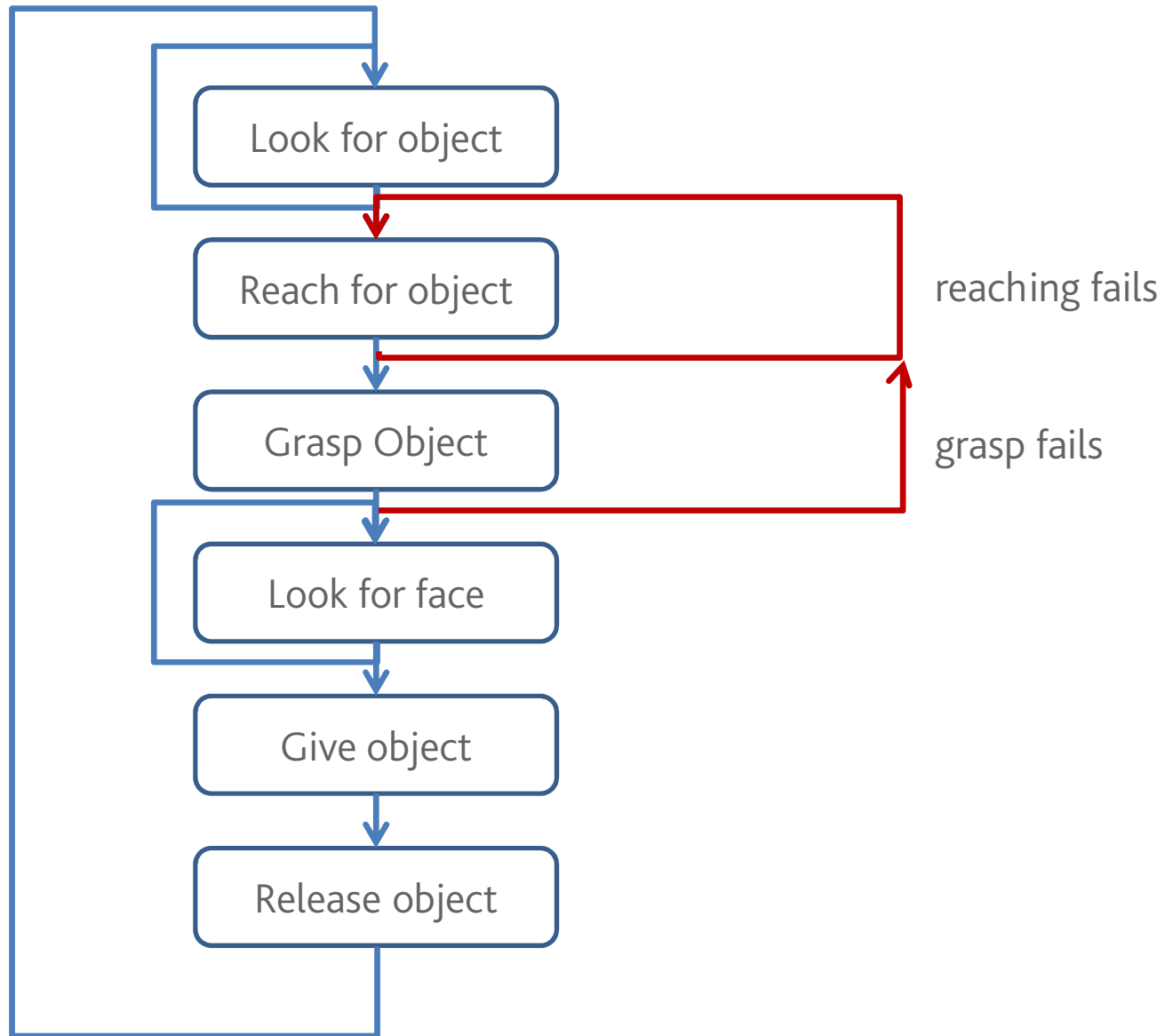




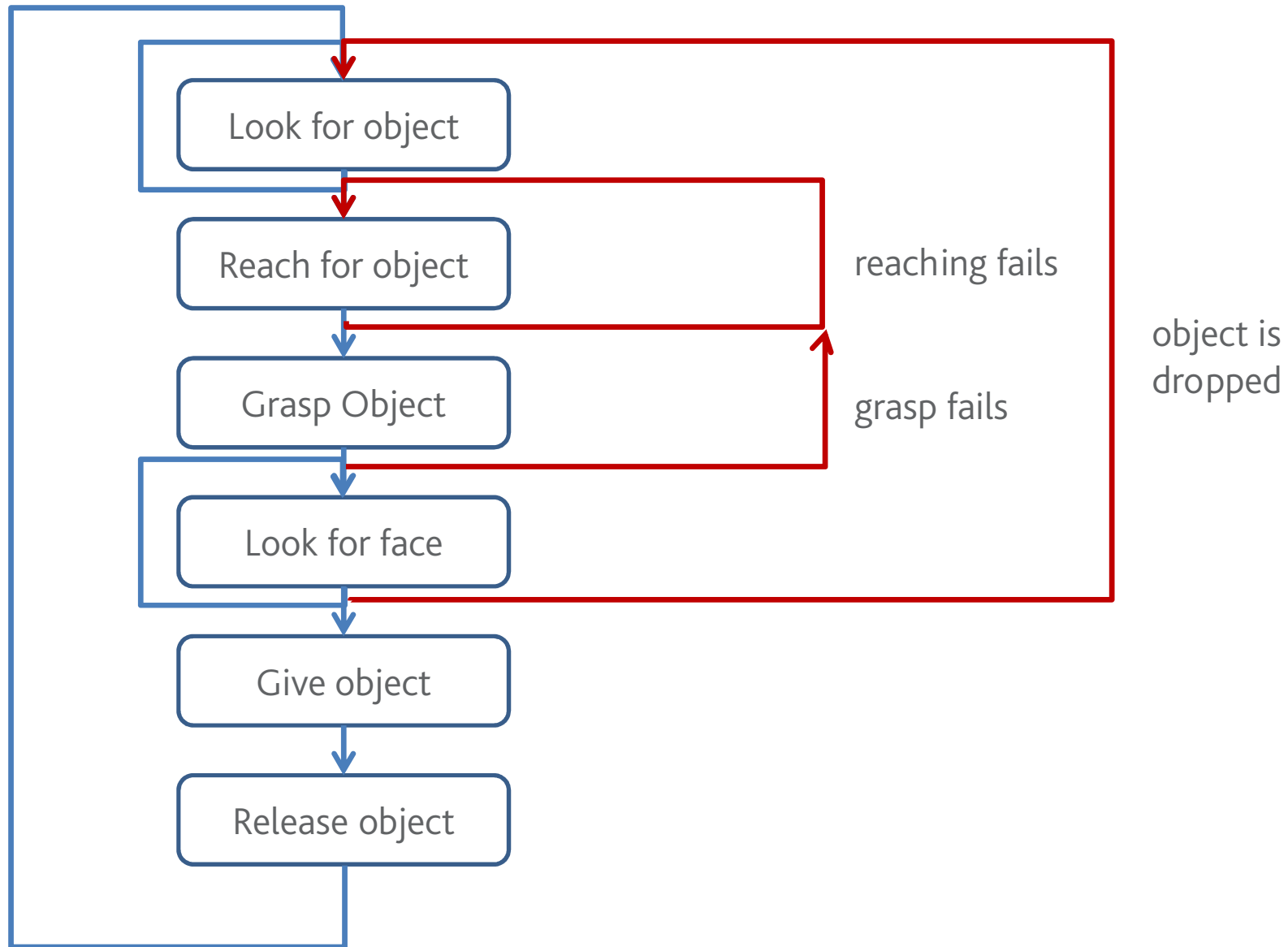
Take & return



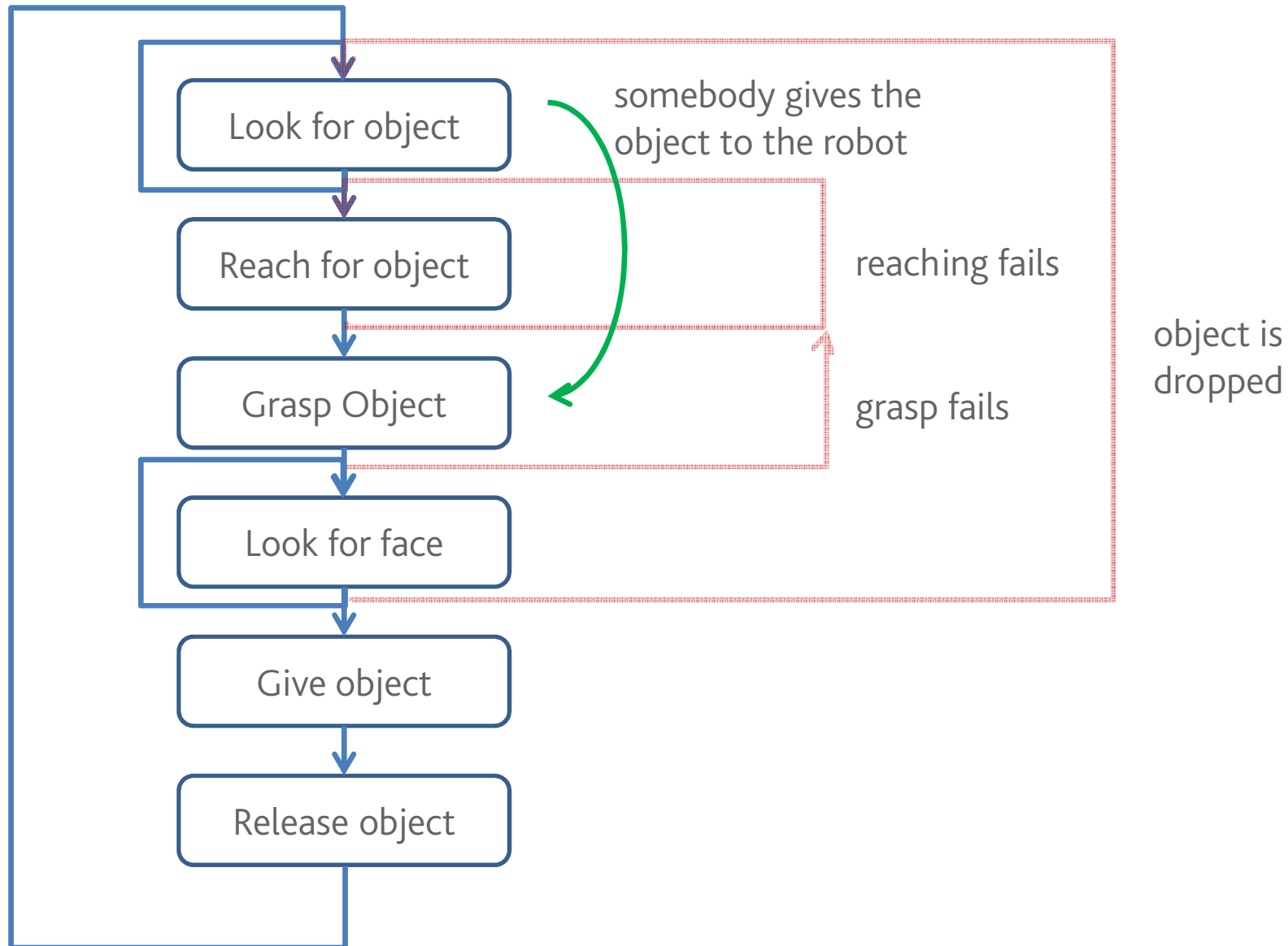
Take & return



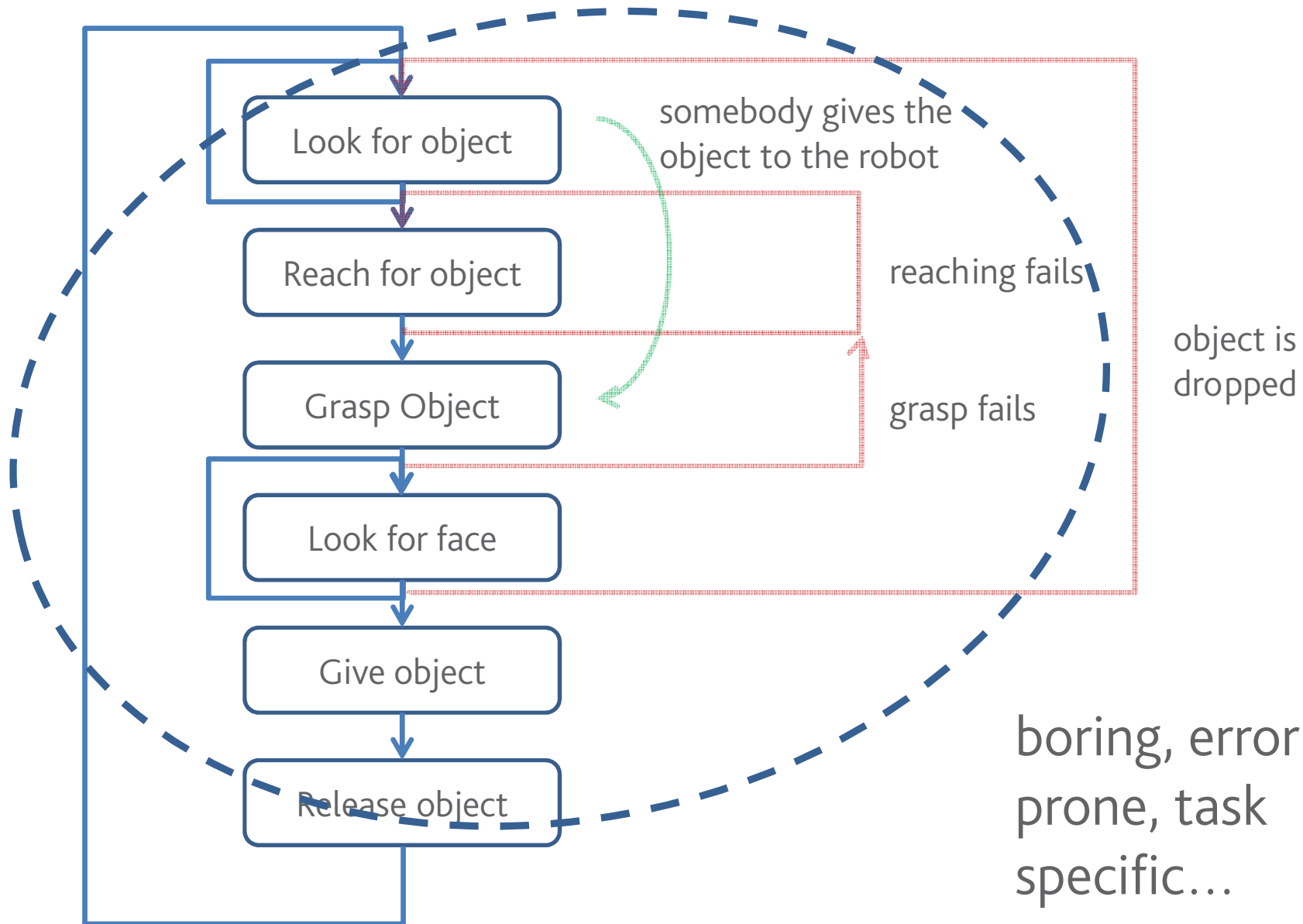
Take & return



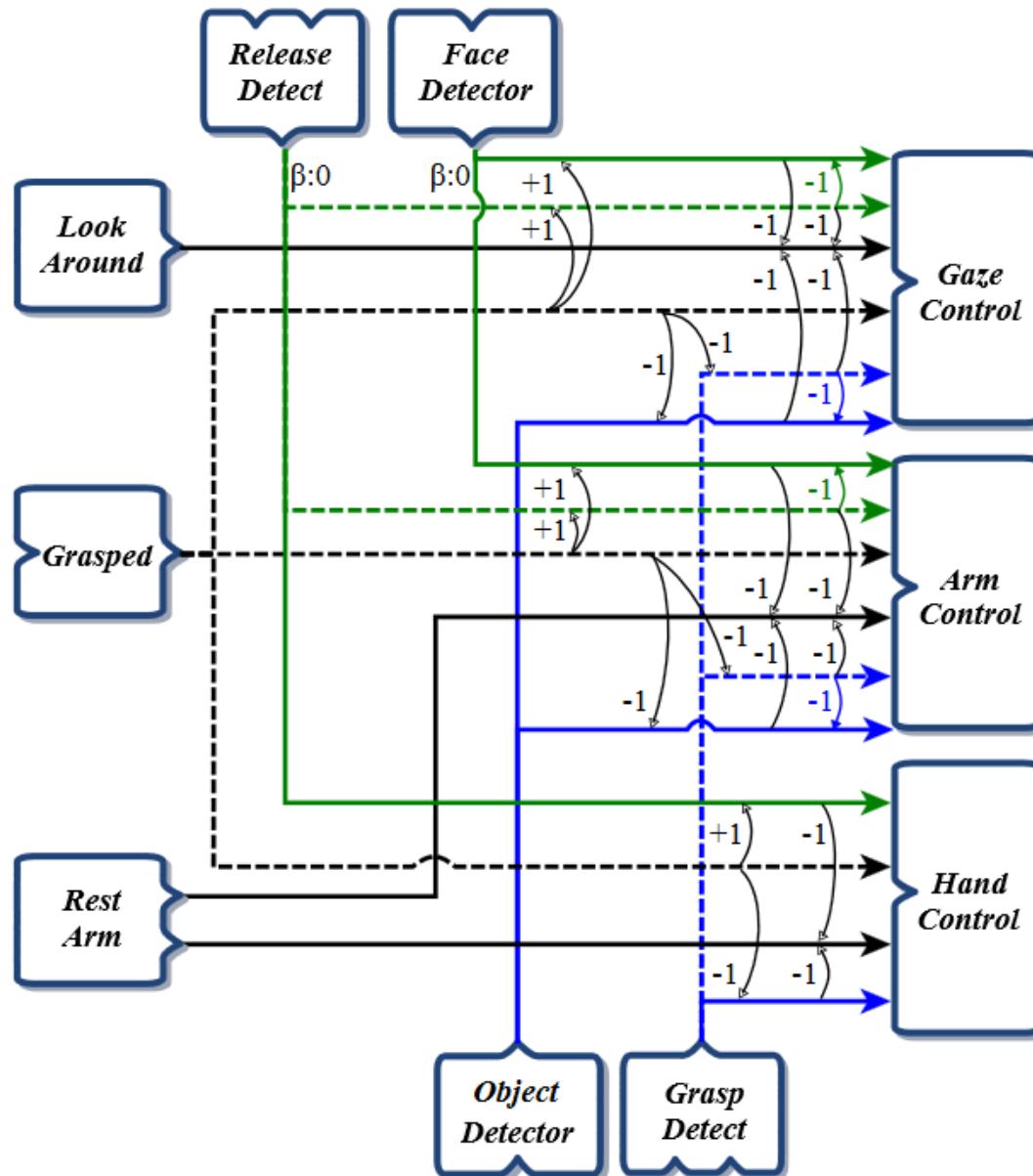
Take & return



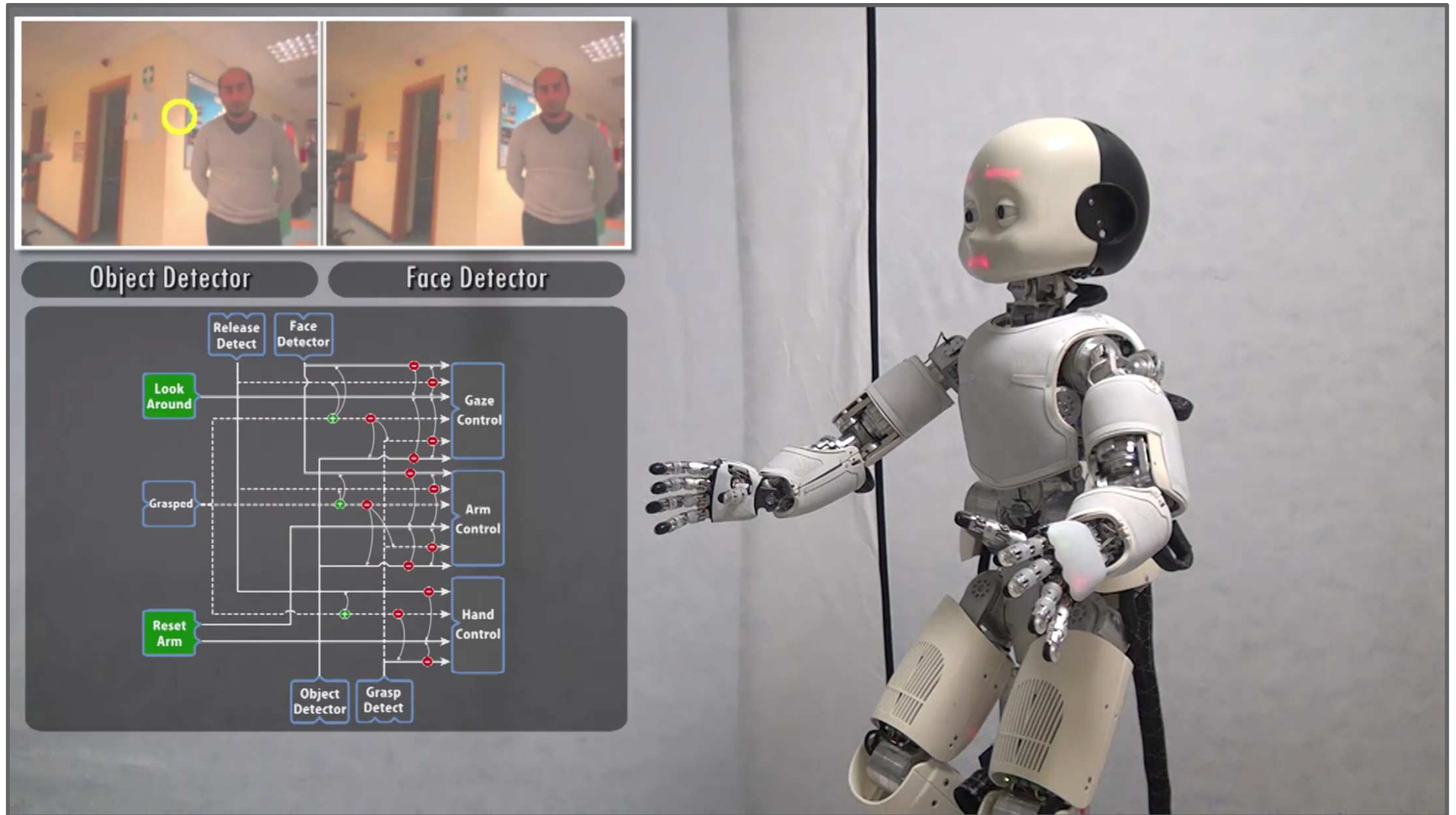
Take & return



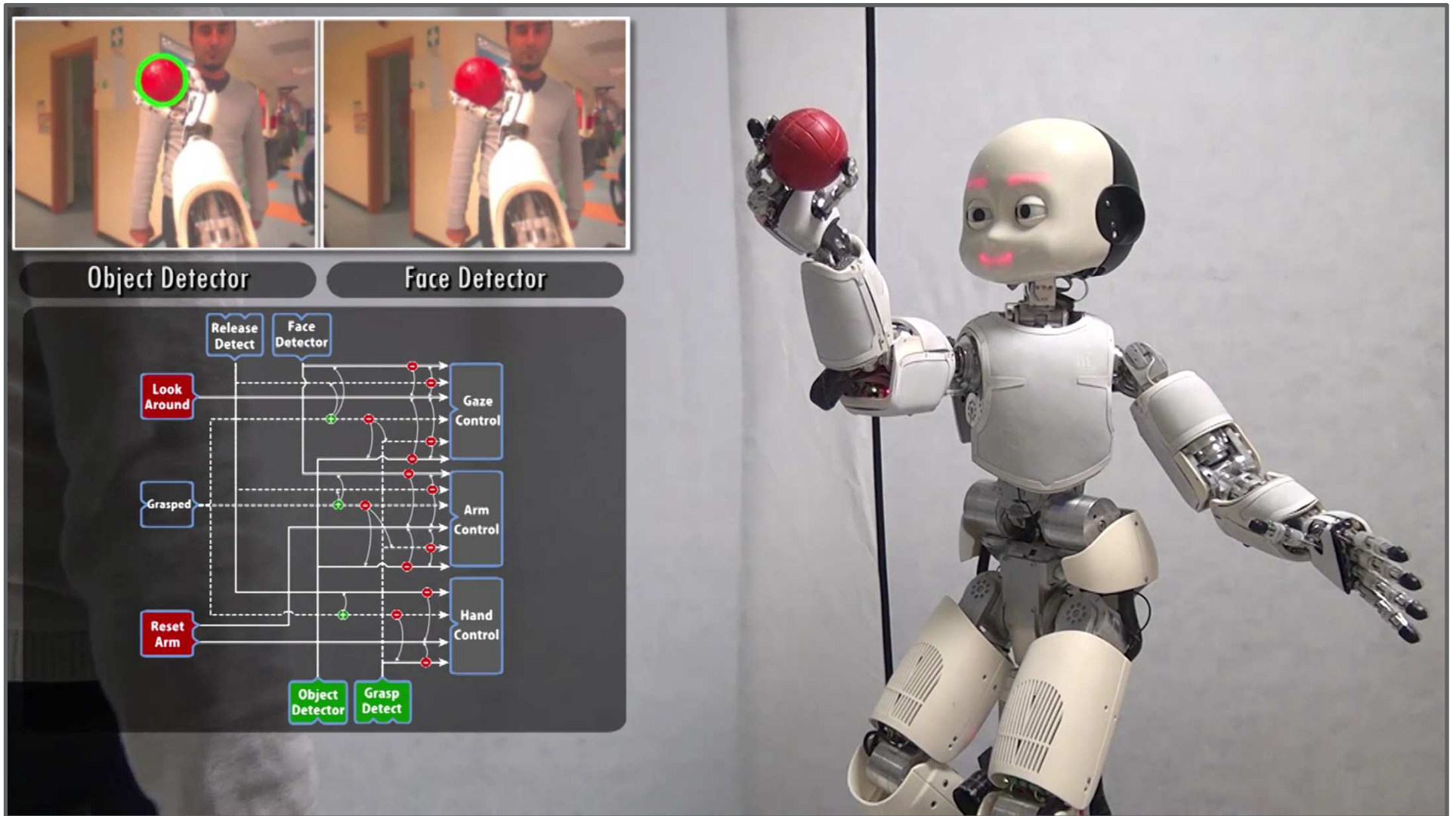
A different approach



- no central coordinator
- all modules can be re-used
- no need for extra connections



See Ali Paikan's presentation during the school



See Ali Paikan's presentation during the school



People

Marco Accame

Valentina Gaggero

Alberto Cardellino

Alessandro Scalzo

Daniele Domenichelli

Paul Fitzpatrick

Ali Paikan

Elena Ceseracciu

Vadim Tikhanoff

Ugo Pattacini

Marco Randazzo

... and many others
at IIT and in the iCub
community



Thank you!